

Proposed Control Measure to Reduce Emissions from Small Off-Road Engines (SORE)

Mobile Source Control Division
Planning and Technical Support
Monitoring and Laboratory Division
California Air Resources Board

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Major Components of the Evaporative Portion of the Proposed SORE Control Measure

- Sets diurnal evaporative emission standards for equipment with engine displacements greater 65 cc
- Sets a fuel tank permeation standard applicable to all SORE categories
- Requires manufactures to label and certify equipment sold in California

Regulatory Approach

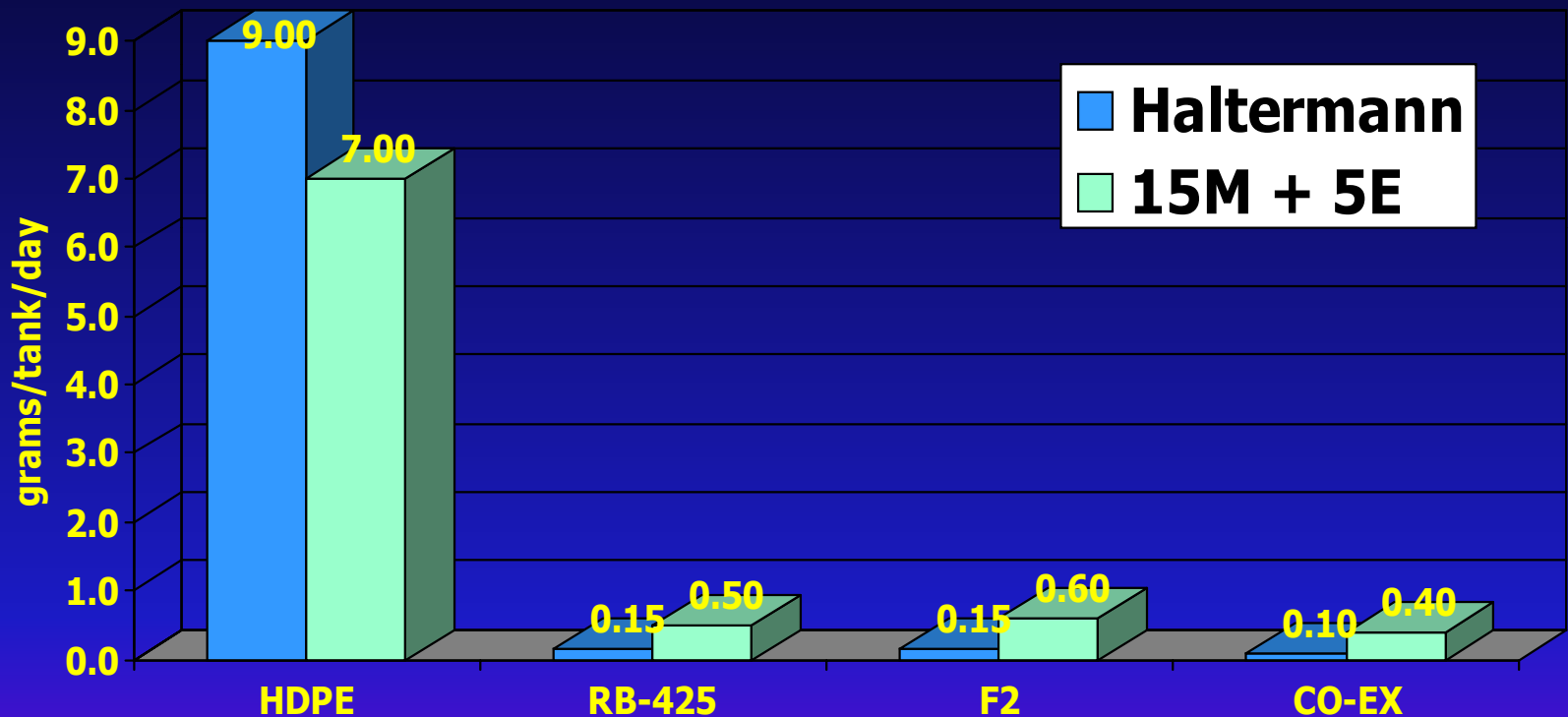
- Use available technology to reduce emissions
- Set attainable and cost effective emission standards
- Limit burden on industry by:
 - Providing either a performance or a design-based certification option
 - Allowing a phased-in implementation schedule

Permeation Technology

- Multi layered co-extruded (Coex) plastic fuel tanks
- HDPE fuel tanks made with Selar® RB-425
- Post fabrication fluorination of HDPE fuel tanks
- Post fabrication sulfonation of HDPE fuel tanks
- Metal fuel tanks
- Fuel connectors made from acetal copolymers and other low permeation thermoplastics
- Fluoroelastomer seals, diaphragms and gaskets

Barrier Treatment Permeation Comparison

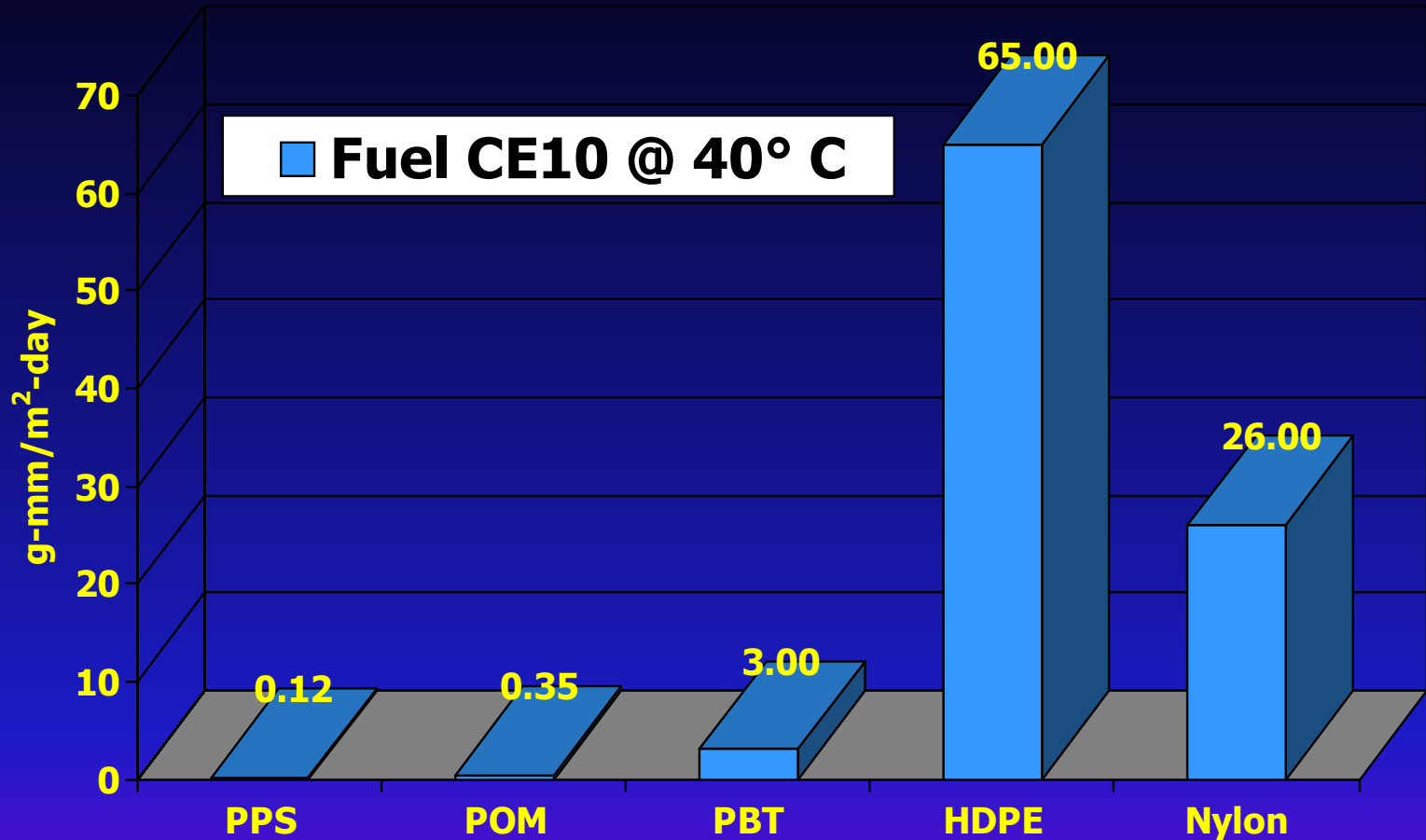
Selar® RB-425 vs. Fluorination and Co-ex with EVOH



Permeability of fuel tanks containing with 7% Selar® and 30% regrind using a 65 - 105 -65° F diurnal profile.

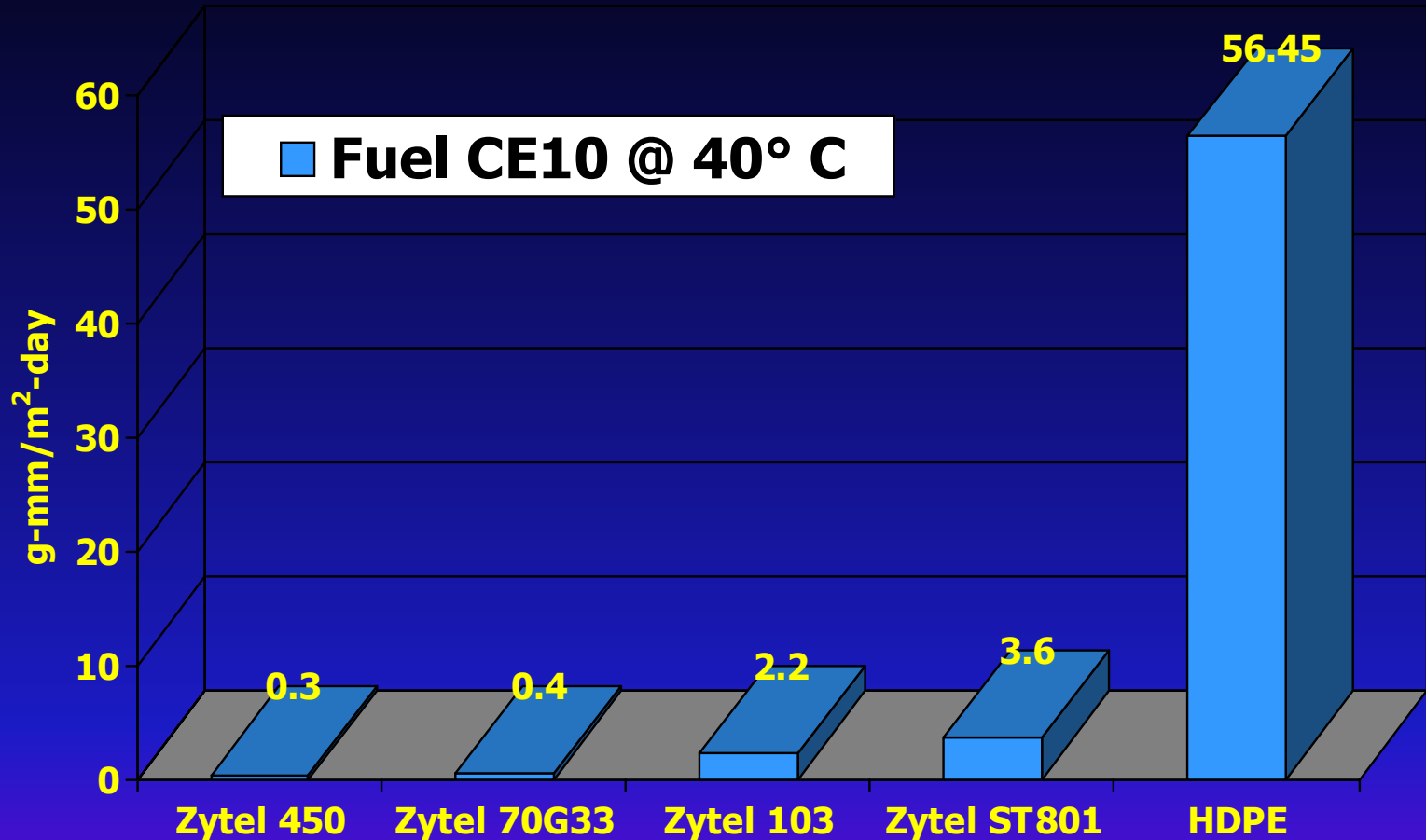
Average values for Fluorination (F2) and co-ex with EVOH.

Polymer Permeation Comparison



- Polyphenylene Sulfide (PPS), Acetal Copolymer (POM)
- Polybutylene Terephthalate (PBT)

Nylon Permeation Comparison



Dupont Zytel® Nylon Products

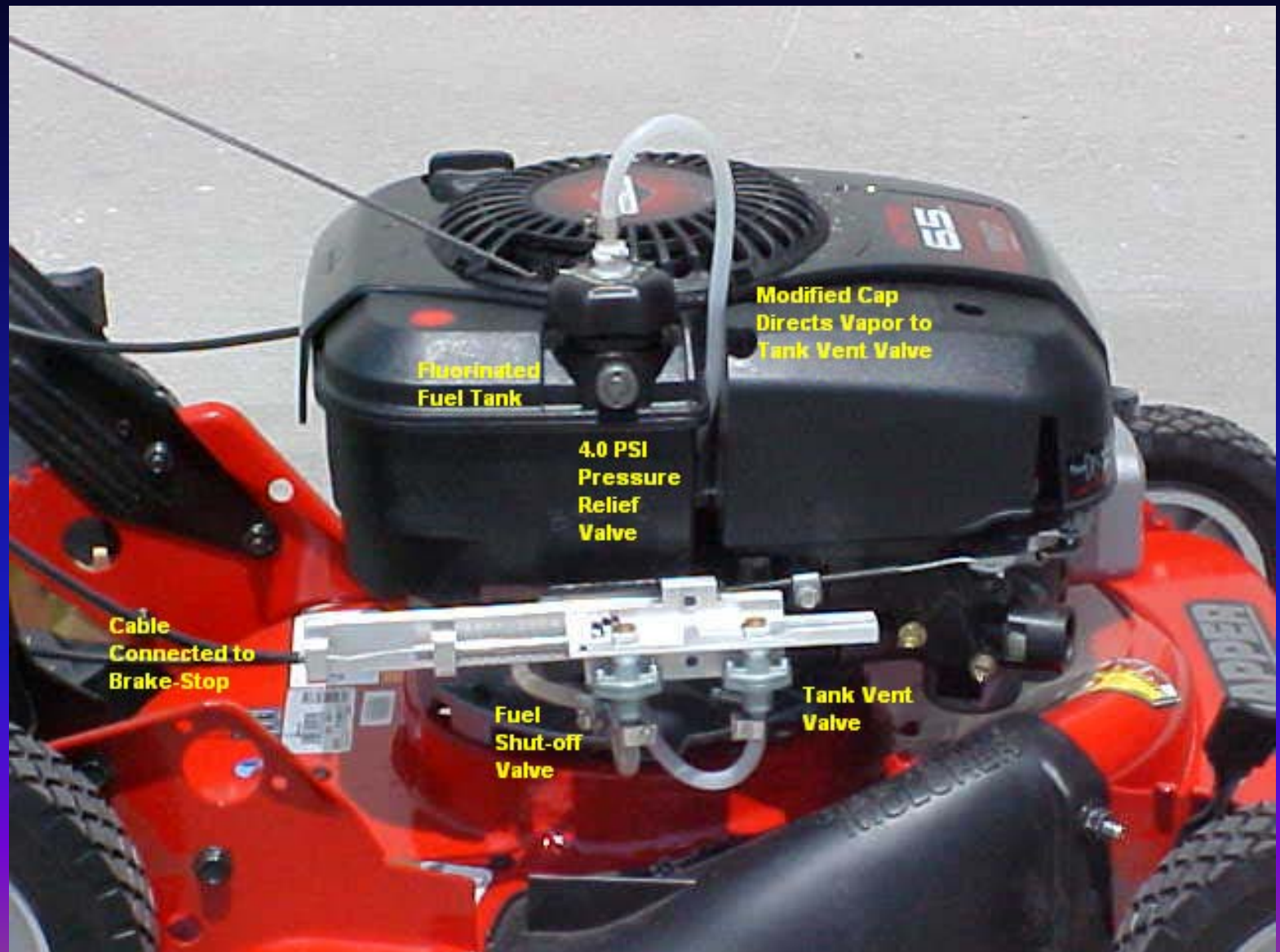
Evaporative Emission Control Technology

- Passively actuated valves that control vapors
- Carbon canisters systems that absorb tank vapors
- Pleated carbon air filters capable of absorbing carburetor vapors
- Hybrid systems that vent tank vapors to a canister above a fixed pressure
- Collapsible fuel bladders

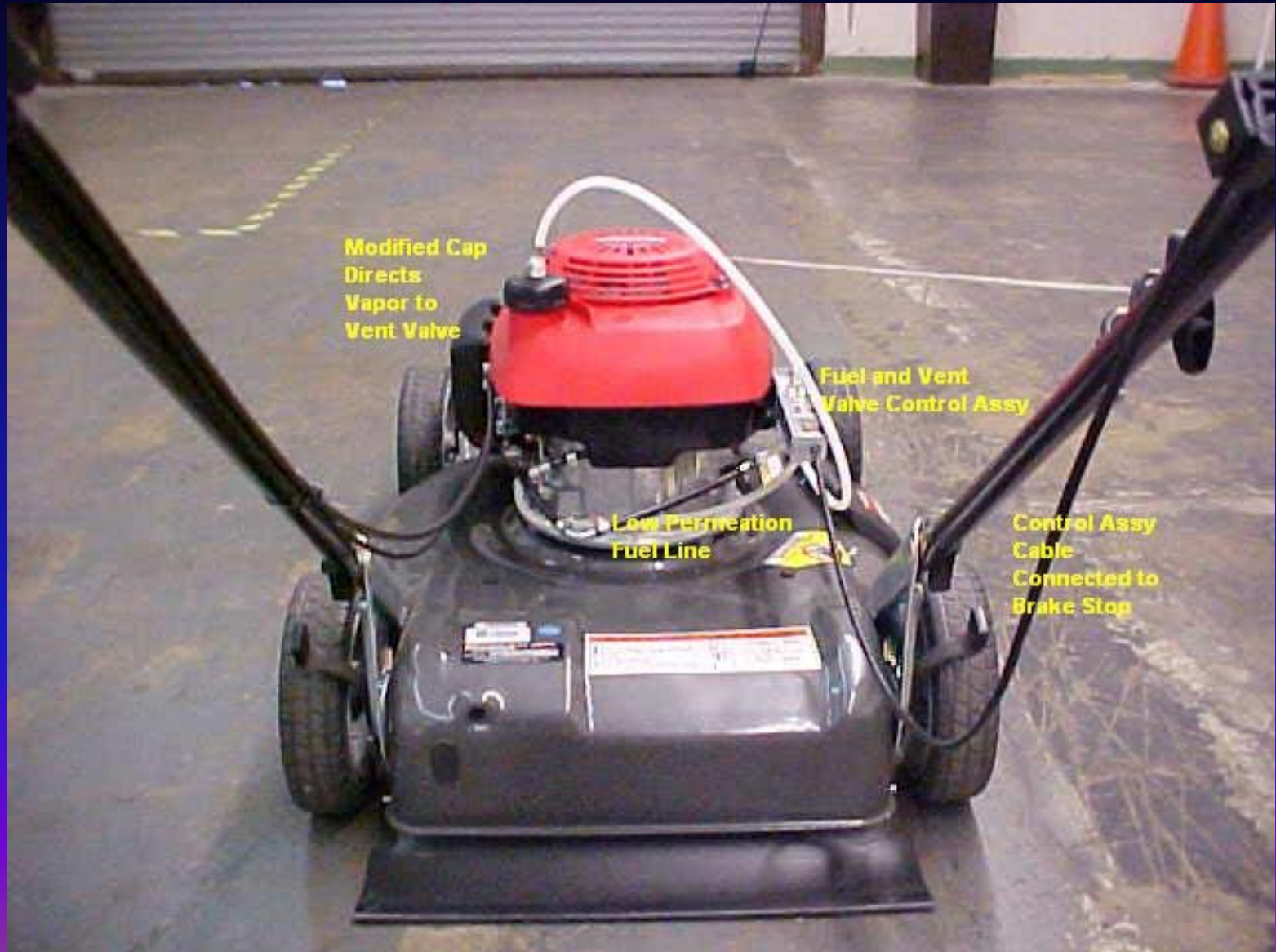
Venting Control Technology Demonstration

- Tested three pairs of walk-behind lawn mowers
- ARB built and tested prototype controls with the following technology:
 - Engine-brake actuated valves that isolate tank vapors during storage
 - Fluorinated HDPE fuel tanks
 - Low permeation fuel lines

Modified Snapper Mower

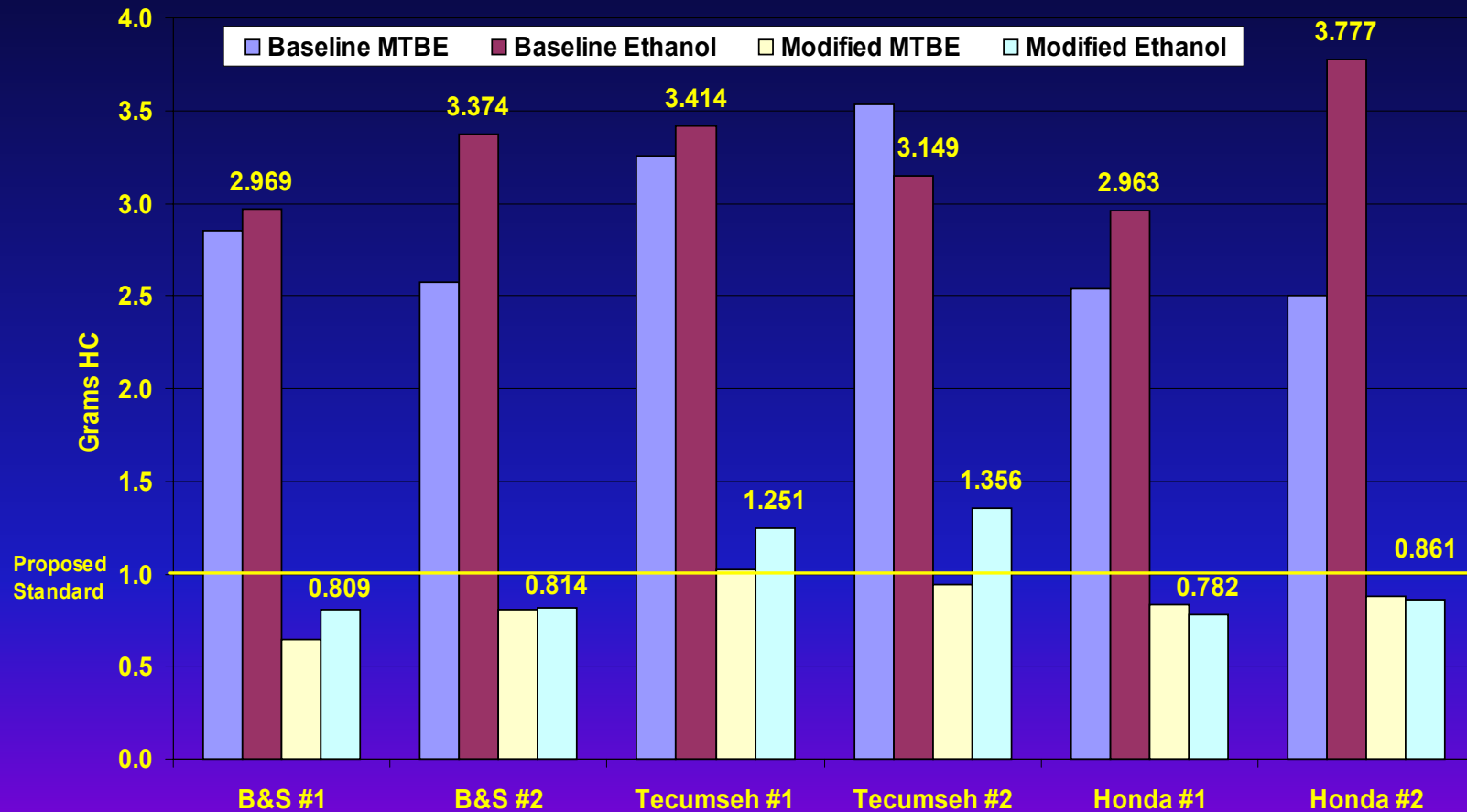


Modified Honda Mower



Venting Technology Demonstration Data

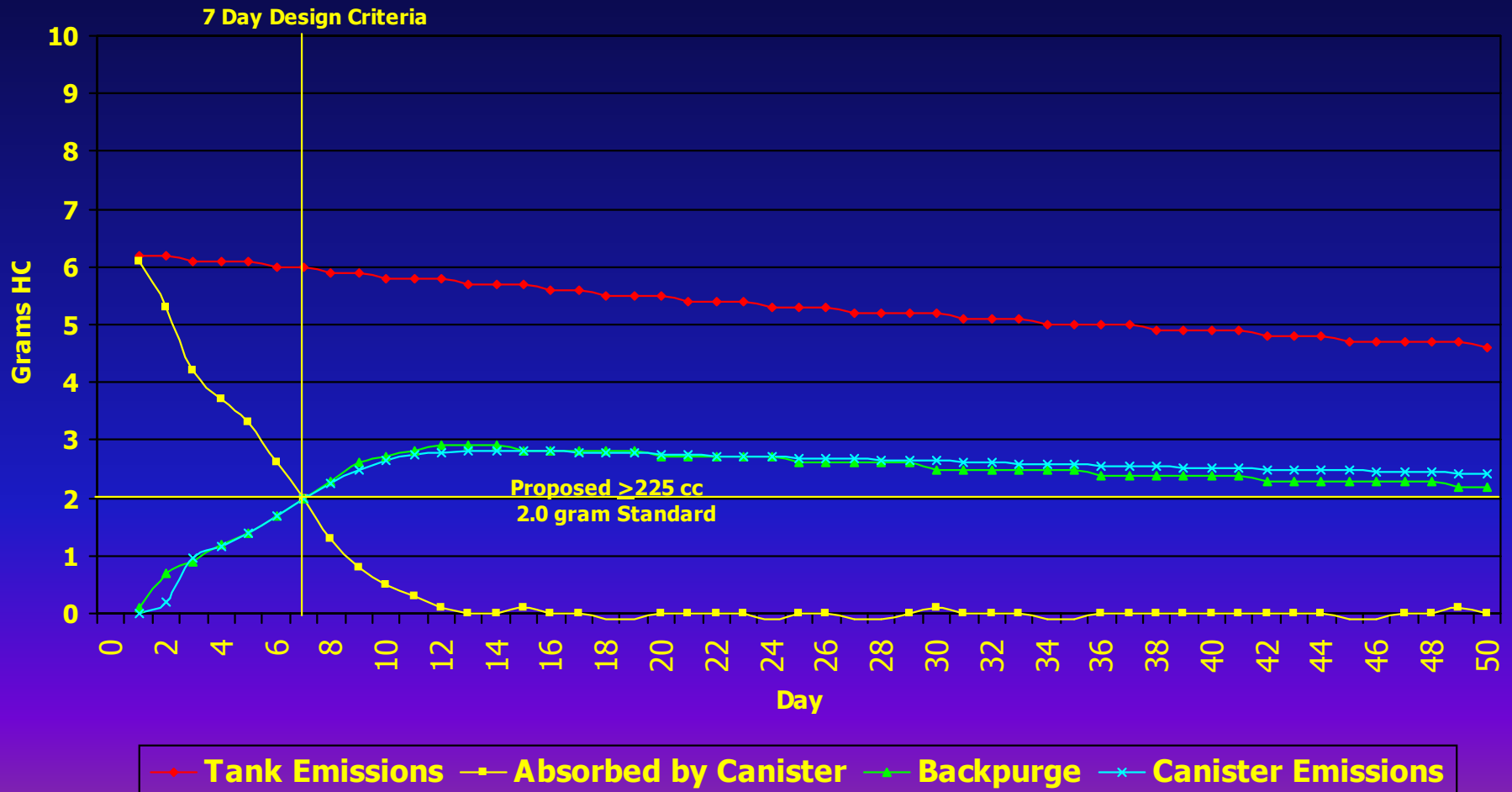
Lawn Mower Evaporative Emission Reduction Data
(24-Hour Diurnal Fuel Comparison)



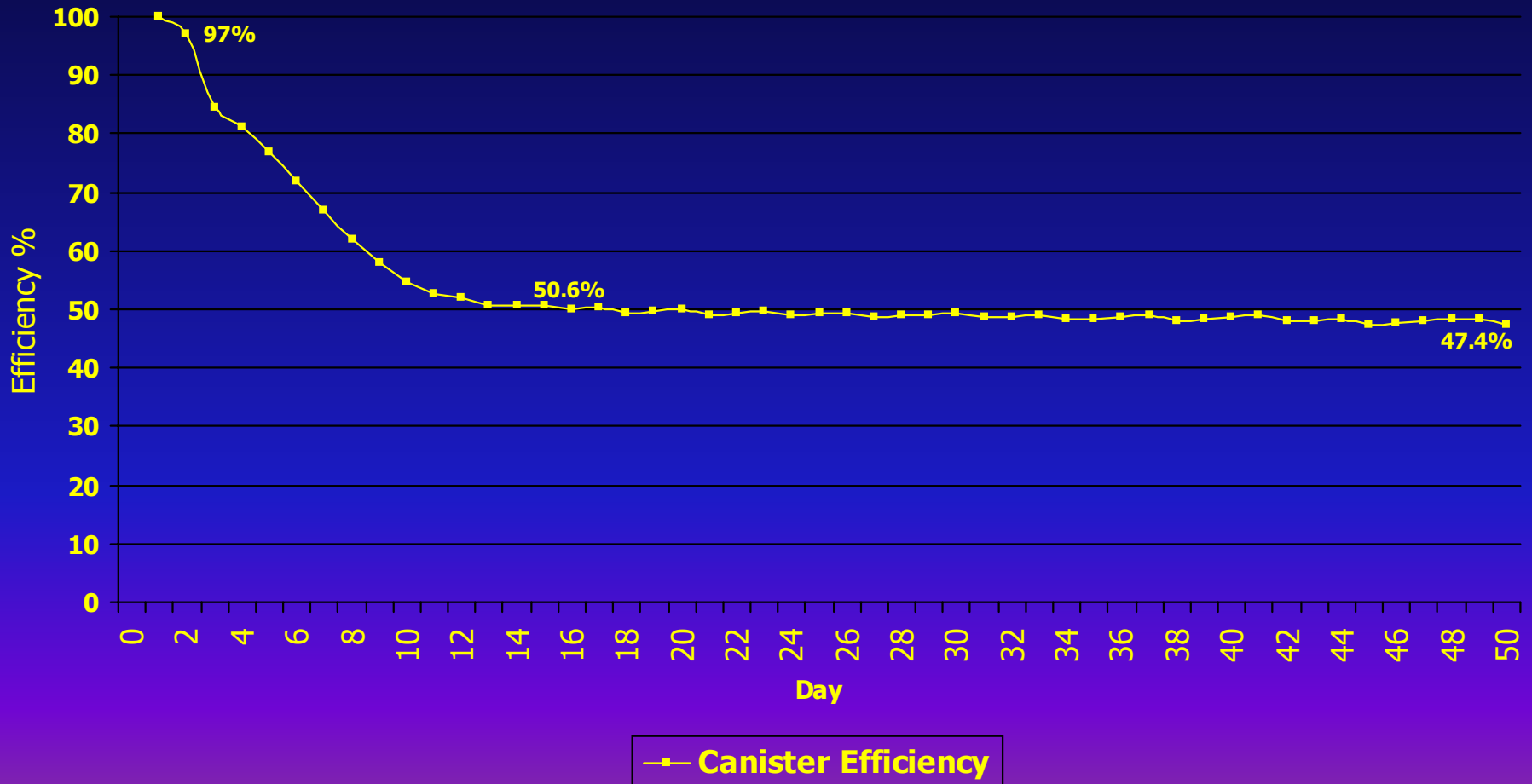
Canister Control Technology Modeling

- Calculated emissions from a 670 cc canister with a working capacity of 36 grams
- Modeled canister performance as if it were attached to a 5 gallon fuel tank filled to 50% capacity
- Assumed a test fuel with a RVP of 7 PSI
- Simulated canister performance over 50 diurnal temperature profiles (65 - 105 - 65°F)
- Worst case long term efficiency determined to be 47%

Canister Modeling Data



Estimated Canister Efficiency



Proposed Evaporative Standards

- 1.0 gram HC/day diurnal standard for equipment with engines $> 65 \text{ cc} < 225 \text{ cc}$
- 2.0 gram HC/day diurnal standard for equipment with engines $\geq 225 \text{ cc}$
- 1.0 gram/meter²/day fuel tank permeation standard for all SORE equipment fuel tanks

Test Procedures

- Staff is reviewing recently adopted U.S. EPA permeation and diurnal emissions test procedures
- TP-901, “Test Procedure for Determining Fuel Tank Permeation Rates Using Gravimetric Analysis”:
 - currently considering a gravimetric test procedure
- TP-902, “Test Procedure for Determining Diurnal Evaporative Emissions from Small Off-Road Engines”
 - is intended for performance-based certification
- Requesting comment on alternative test procedures

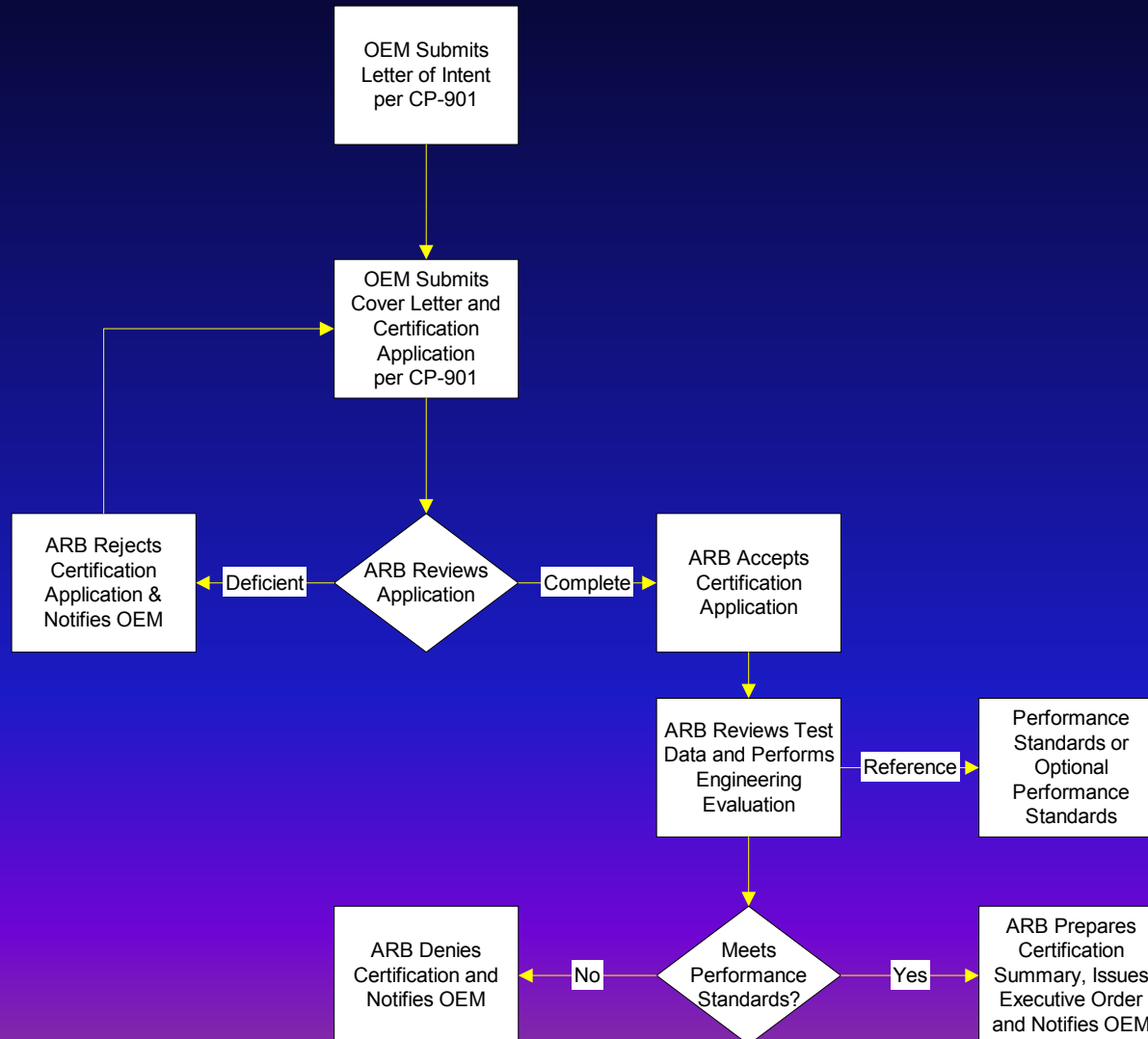
In-Use Durability Test

- Staff is developing a test procedure that duplicates the cycles of use of systems/components
- Test procedure currently assumes 7 year useful life
- Accelerated aging would simulate usage and consider hour of operation
- Staff is currently seeking comment on durability test procedures

Certification Options

- Certify equipment to performance standards (CP-901 Part I)
- Certify equipment to design standards (CP-901 Part II)
- Certify control components/systems (CP-901 Part III)
 - Fuel tank permeation (CP-901 Appendix A)
 - Venting control (CP-901 Appendix B)
 - Fuel hose permeation (CP-901 Appendix C)

Performance-Based Certification Overview



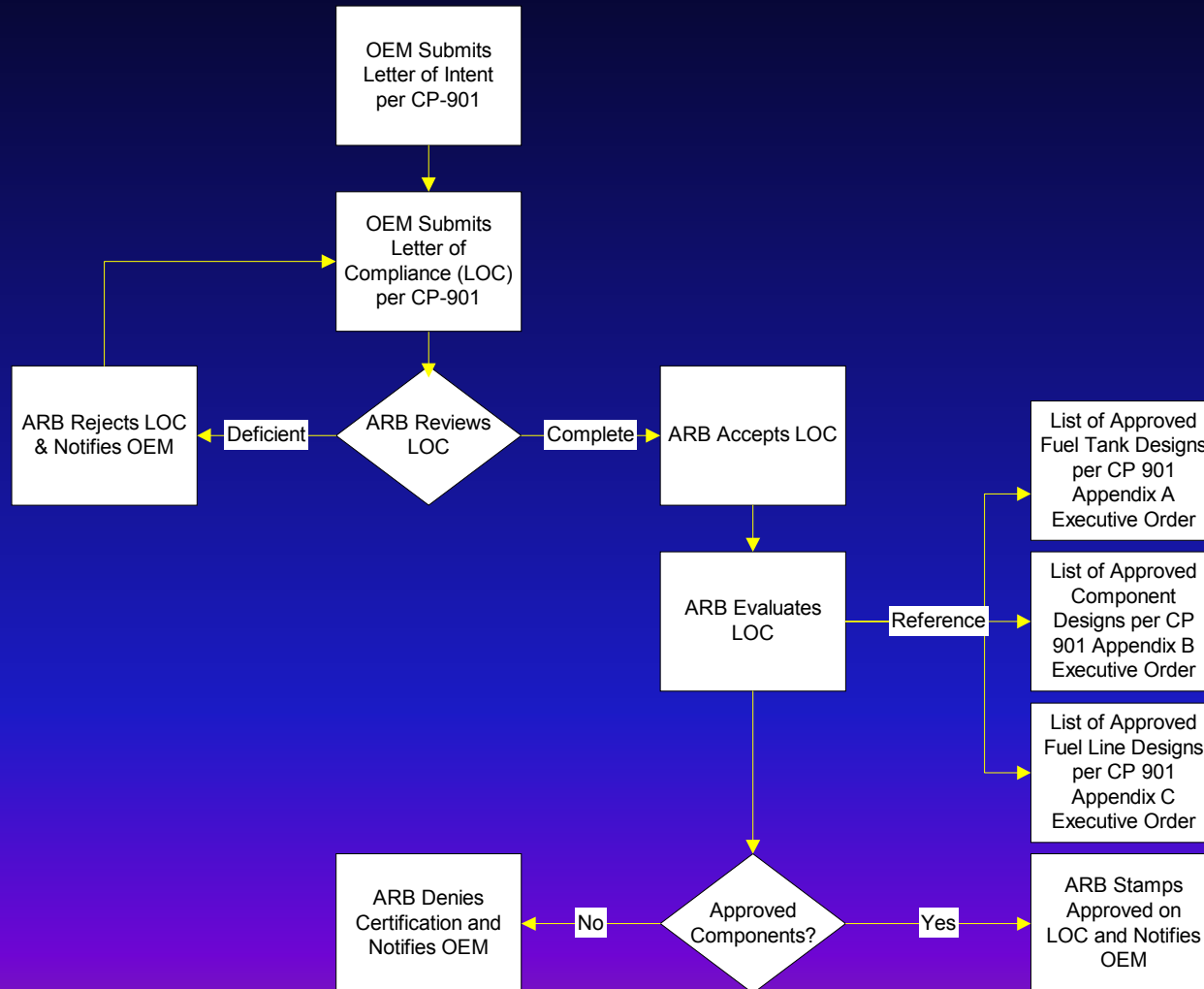
Performance-Based Certification Requirements

- Group equipment models into evaporative families
- Measure emissions for the highest emitting equipment within the evaporative family
- Submit an evaporative emissions label for ARB approval
- Submit a certification application that includes:
 - Performance-based certification summary sheet
 - Certification Database Form

Performance-Based Testing Requirements

- Performance-based certification requires gravimetric testing (all SORE tanks) and SHED testing for engines > 65 cc
 - Select a model in the evaporative family that is expected to exhibit worst-case emissions
 - Conduct emission testing per applicable test procedure TP-901 or TP-902
 - Results must not exceed applicable standard

Design-Based Certification Overview



Design-Based Certification Requirements

- Select approved emission control equipment
- Group equipment into evaporative families
- Submit an evaporative emissions label for ARB approval
- Submit a letter of compliance that includes:
 - Design-based certification summary sheet
 - Certification database form

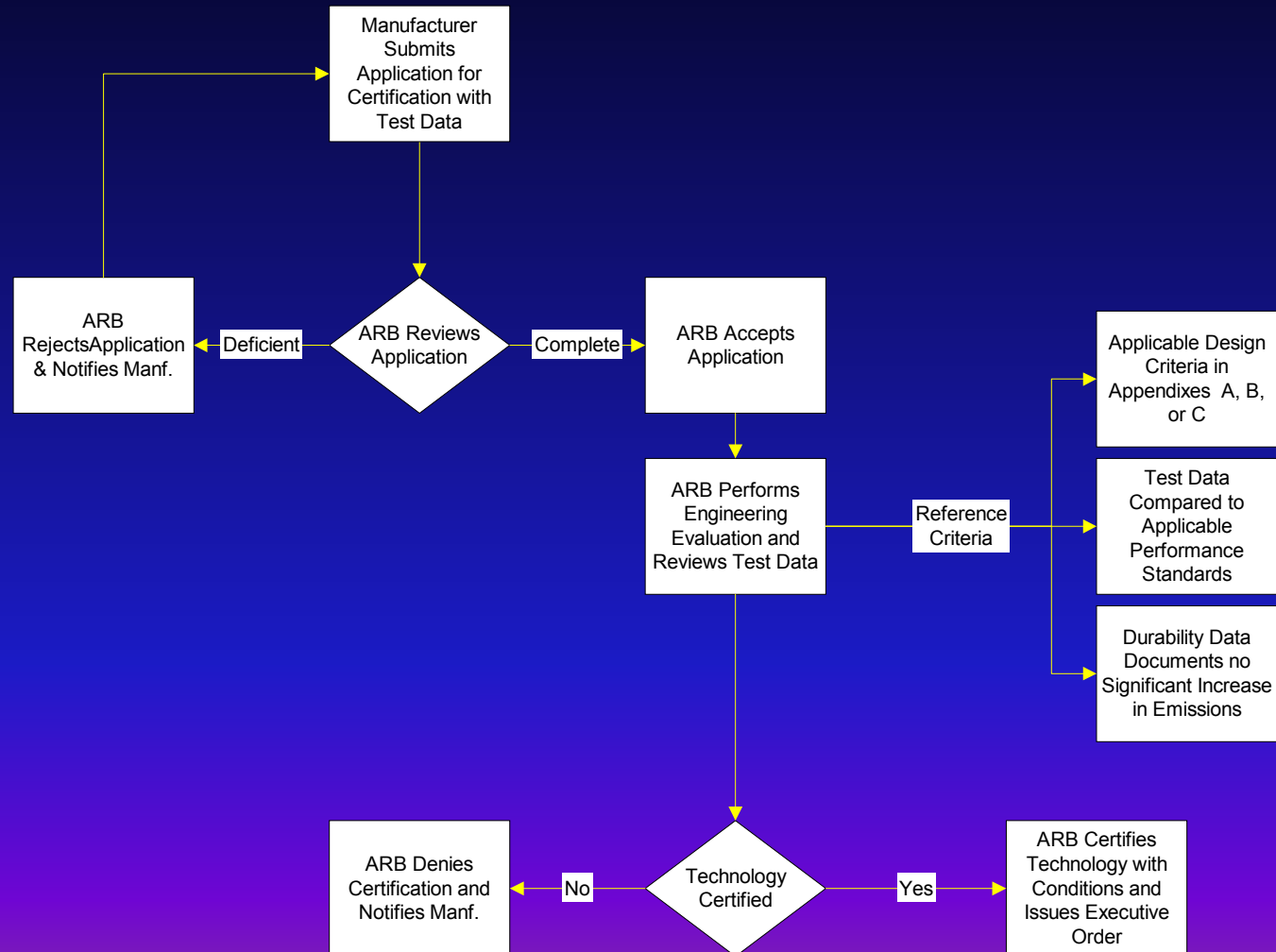
Design-Based Certification Summary Sheet Requirements

- Certification Summary must specifically reference:
 - Executive Order number from CP-910 Appendix A that approves the fuel tank permeation control
 - Executive Order number from CP-901 Appendix B that approves the system used to control vapors generated by the fuel tank
 - Executive Order number from CP-901 Appendix C that approves the low permeation fuel line

Design-Based Equipment Requirements

- Control equipment must include:
 - Fuel tank permeation control
 - System to control vapors generated by the fuel tank
 - Self-locking, tethered fuel cap
 - Low permeation fuel line that meets SAE J30 R11, J30 R12A, or J2260 category one specifications

Control System Certification Overview



Control System Certification Process

- Submit a certification application containing:
 - cover letter with test data
 - engineering description of control system
 - durability demonstration
 - statement of materials compatibility with fuels
 - any maintenance requirements
 - warranty
- System will undergo an engineering evaluation that may include:
 - evaluation of system concept
 - bench testing of components
 - failure mode testing

Next Steps

- Incorporate stakeholder comment on proposed regulatory language and certification procedures
- Post and take comment on test procedures TP-901 and TP-902
- Prepare staff report

Contacts and Additional Information

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SORE Web Page URL

<http://www.arb.ca.gov/msprog/offroad/sore/sore.htm>